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Taxonomic revision of the *Carebara oni* species group, with descriptions of two new species from Vietnam (Hymenoptera, Formicidae, Myrmicinae)

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Abstract

The myrmicine genus *Carebara* is comprised of subterranean ants mainly distributed in tropical and subtropical regions. Based on morphological characters found in the major and minor worker subcastes, we established that the *Carebara oni* species group is comprised of three species: *C. eguchii* **sp. nov.**, *C. bifida* **sp. nov.**, and *C. oni* (Terayama). The two new species were collected from Mt. Phansipan and Cuc Phuong National Park, respectively, in northern Vietnam. Members of this species group are distinguished from other congeners by the massive mesosoma in major workers, the pronounced median clypeal projections in minor workers, and the nine-segmented antennae and six-toothed mandibles in both worker subcastes. Herein, we describe the new species, provide diagnostic characters for the species group, and present a worker-based identification key to species.

Key Words

ants, subterranean, species group, identification key, worker subcaste, nest series, tropical Asia

Introduction

The myrmicine genus *Carebara* Westwood, 1840 is distributed worldwide, mainly in tropical and subtropical regions. To date, 230 valid species have been described (Bolton 2025) and many undescribed species are believed to exist (Fischer et al. 2014). A recent phylogenetic study placed the genus within the tribe Crematogastrini (Ward et al. 2015). Most species are subterranean and are typically collected from leaf litter, under stones, or in decaying or rotten wood.

The genus *Carebara* was established by Westwood (1840), with *C. lignata* designated as the type species. *Carebara* s. str. is mainly characterized by blind and small worker castes, which are typically monomorphic (Ettershank 1966). Later, several genera have been synonymized with *Carebara* based on morphological similarities: Fernández (2004) for *Oligomyrmex*, *Paedalgus*, *Afroxyidris*, and *Neoblepharidatta*; Fernández (2010) for *Parvimyrma*; and Fischer et al. (2014) for *Pheidologeton*. Subsequent phylogenetic studies using nuclear regions and ultraconserved elements have confirmed close phylogenetic relationships among *Carebara* s. str., *Pheidologeton*, and *Oligomyrmex* (Ward et al. 2015; Blaimer et al. 2018). Notably, the former *Oligomyrmex* and *Pheidologeton* are characterized by worker dimorphism and worker polymorphism, respectively.

However, recent findings are beginning to reveal new insights into the worker caste differentiations. *Carebara* s. str. was considered to be worker monomorphic, but recent reports have described *C. fayrouzae*, which fits the

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morphological definitions of *Carebara* s. str. but which yet possesses major workers (Sharaf and Aldawood 2013). Additionally, former *Oligomyrmex* typically show worker dimorphism, but continuous polymorphism has been observed in major workers of Afrotropical species (Azorsa and Fisher 2018).

In tropical Asia, several *Carebara* species have been described, making the region highly diverse for the genus. To date, 36 species and subspecies have been recorded from China, 26 from Indonesia, 14 from Vietnam, 11 from Thailand, 10 from Philippines, 8 from Taiwan, 7 from Laos and Japan, 6 from Malay Peninsula, 5 from Singapore, and 4 from Borneo, Brunei Darussalam, Cambodia, and Myanmar based on literature records. However, owing to limited systematic studies, many unidentified species, particularly dimorphic *Carebara* species (former *Oligomyrmex*), have been documented in faunal surveys conducted in the region (e.g., Yamane et al. 2002 and Eguchi et al. 2011 for Vietnam; Eguchi and Yamane 2003 and Heterick and Kitching 2022 for Brunei Darussalam; Hosoishi et al. 2013, 2017 for Cambodia; Leong et al. 2017 for China; Yamane et al. 2018 for Borneo; Ito et al. 2024 for Indonesia). Extensive taxonomic studies have been conducted regionally in Japan (Terayama 1996; Terayama et al. 2014; Yamane et al. 2025), China (Li and Tang 1986; Wu and Wang 1995; Zhou and Zheng 1997; Xu 2003; Zhou et al. 2006; Liu et al. 2024), Taiwan (Terayama 2009; Terayama et al. 2012), Cambodia (Hosoishi et al. 2022; Matsuura et al. 2024), Thailand (Jaitrong et al. 2021; Wimolsuthikul et al. 2024), and India (Bharti and Kumar 2013; Bharti et al. 2014; Akbar and Bharti 2017; Dhadwal and Bharti 2022). However, in Asia, few researchers have discussed species groups of dimorphic *Carebara* species (former *Oligomyrmex*) based on worker morphology. Taxonomic research at the species group–level is valuable (Ward 2007), especially in genera that contain a large number of species, e.g., *Aenictus* by Jaitrong and Yamane (2011), *Camponotus* by Rakotonirina et al. (2016), *Leptogenys* by Arimoto (2017), *Pheidole* by Salata and Fisher (2020), and *Tetramorium* by Hita Garcia and Fisher (2011).

In a first attempt to develop a classification system for dimorphic *Carebara*, this study focuses on *C. oni* (Terayama, 1996) and its close relatives. In their revision of the Chinese species, Liu et al. (2024) suggested that *C. altinoda* (Xu, 2003), *C. hunanensis* (Wu & Wang, 1995), *C. oni*, and *C. qianliyan* Terayama, 2009 are closely related and form a distinct species group based on several characters. However, some characters mentioned by these authors are sometimes obscure because of inter- or intraspecific variation. The resolution of such taxonomic problems requires careful analysis of character variation using colony-based samples.

In this study, we establish the *C. oni* species group based on major and minor worker subcastes using specimens collected from Vietnam and Japan. The group is well-defined based on worker morphology. We also provide diagnostic characters for the group, descriptions of two new species, and an identification key to species.

Material and methods

Observations

Observations were conducted using an Olympus SZX16 (Olympus Corporation, Tokyo, Japan) stereomicroscope. Multi-focused montage images were created with Zerene Stacker ver. 1.04. Source images were taken with a Sony α7R IV and a Canon MP-E 65 mm lens. Morphological measurements were performed using Motic Images Plus 2.4S (Shimadzu Rika Corporation, Tokyo, Japan). All measurements are expressed in millimeters and recorded to the second decimal place. The scanning electron micrographs (SEM) were prepared with a SU3500 (Hitachi High-Tech Corporation, Tokyo, Japan) scanning electron microscope. The samples were sputter-coated with gold (Ion Sputter MC1000, Hitachi High-Tech Corporation, Tokyo, Japan).

Source of material

Voucher specimens of the newly described species are deposited in the Vietnam National Museum of the Nature, Hanoi, Vietnam (**VNMN**), Seiki Yamane Collection, Japan (**SKYC**), the Institute of Tropical Agriculture, Kyushu University, Fukuoka, Japan (**KUEC**), and the Ant Collection of Katsuyuki Eguchi (**ACEG**).

Measurements and indices

Measurements are based on Azorsa and Fisher (2018) with slight modifications (Fig. 1). All measurements are given in millimeters. Abbreviations used for measurements and indices are as follows: **TL** – Total length: the sum of the lengths of the head, mesosoma, waist, and gastral tergite I viewed in profile. It includes the mandible and excludes the sting. **HL** – Head length: maximum length of cranium in full-face view, measured from the anterior-most point of the anterior clypeal margin to the posterior-most point of the posterior cephalic border. **HW** – Head width: maximum width of cranium in full-face view (excluding eyes). **SL** – Scape length: maximum length of antennal scape excluding basal condylar bulb. **EL** – Eye Length: maximum diameter of compound eye. **ML** – Mesosomal length: maximum diagonal length of the mesosoma in profile view, measured from posterodorsal border of pronotal flange to posterior margin of propodeal lobe. **MW** – Mesosomal width: maximum width of promesonotum in dorsal view. **PSL** – Propodeal spine length: distance from center of propodeal spiracle to apex of the propodeal spine in profile view. **PSD** – Propodeal spiracle diameter: diameter of the propodeal spiracle in profile view. **PL** – Petiolar length: maximum length of the petiole in profile view. **PH** – Petiolar height: maximum height of the petiole in profile view (excluding subpetiolar process). **DPW** – Dorsal petiolar width: maximum width of the petiole in dorsal view. **PPL** – Postpetiolar length: maximum length of the postpetiole in profile

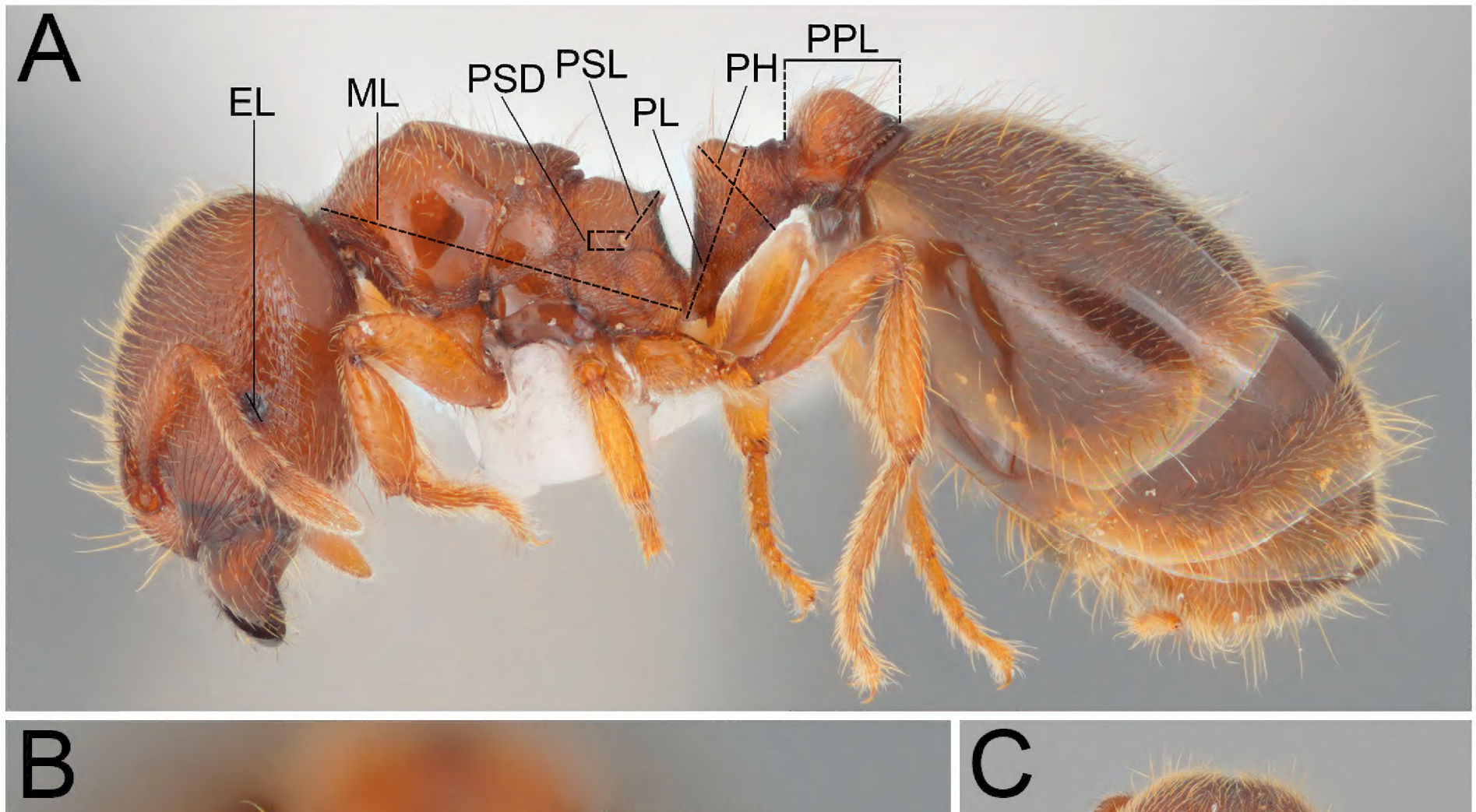

Figure 1. A–C. Measurements of workers, *Carebara oni* (Terayama), major worker. **A.** Profile view of body; **B.** Head in full-face view; **C.** Dorsal view of body.

view. **CI** – Cephalic index: HW/HL × 100. **SI** – Scape index: SL/HL × 100. **PI1** – Petiolar index 1: PL/PH × 100. **PI2** – Petiolar index 2: DPW/PL × 100.

Species groups in *Carebara*

Several studies have proposed species groups and complexes within *Carebara*. Fernández (2004), in a taxonomic review of New World *Carebara* species, suggested the *C. concinna*, *C. lignata*, and *C. escherichi* species complexes. Subsequently, Fernández (2010) tentatively proposed two additional groups: the *C. alperti* and *C. crigensis* groups. Bharti and Kumar (2013) revised the *C. concinna*, *C. escherichi*, and *C. lignata* groups based on Indian *Carebara* species. On synonymizing former *Pheidologeton* with *Carebara*, Fischer et al. (2014) established and revised the *C. polita* species group, which encompasses Afrotropical and Neotropical species. Fischer et al. (2015) examined the *C. phragmotica* clade in the Afrotropics,

which comprises species with phragmotic workers; however, they noted that molecular data did not support monophyly of this group. More recently, the *C. pygmaea* species group was established by Jaitrong et al. (2021) and revised in Cambodia (Matsuura et al. 2024) and Thailand (Wimolsuthikul et al. 2024). In Asia, Hosoishi et al. (2022) established the *C. acutispina* group, though Liu et al. (2024) later indicated that this grouping might be artificial.

In summary, the following groups have been revised based on Old World taxa: the *C. concinna*, *C. escherichi*, *C. lignata*, and *C. pygmaea* species group. However, since the *C. concinna* species group corresponds to former *Oligomyrmex*, the *C. oni* species group seems to be included within this group. Furthermore, the delimitation between *C. concinna* and *C. lignata* species groups is different depending on authors (Bharti and Kumar 2013; Fischer et al. 2015; Liu et al. 2024). To avoid confusion, herein, the *C. oni* species group will be compared with the *C. escherichi* and *C. pygmaea* species groups.

Intermediates

The existence of the intermediates/intercastes that differ in morphological characters such as ocelli and body size has been reported for the major worker ants of *Carebara* (Kusnezov 1951; Fernández 2004, 2006; Azorsa and Fisher 2018). All species in the *C. oni* species group, established in this study, show gradual morphological differences in major worker subcastes. The main variations observed among intermediates are as follows: head length; mesosomal length; number of ocelli (one to three); size of the eyes; forward convexity of promesonotal suture in dorsal view; development of propodeal spine. In this study, individuals with the smallest head length were designated as intermediate 1. All morphological variations observed will be cited in the species descriptions and remarks. An individual exhibiting stable morphological characters among the intermediates identified will be designated as the type specimen.

Results

Taxonomy

Diagnosis of the *Carebara oni* species group

The *Carebara oni* species group can be distinguished from other dimorphic Asian *Carebara* species by the combination of following characters ("MJ" and "MN" represent major and minor worker, respectively) (Fig. 2):

[MJ01] Antennae with nine segments; when antennal scapes laid back, not surpassing posterior cephalic margin;
[MJ02] Shape of head subsquare in full-face view (CI 88–98);
[MJ03] In full-face view, posterior cephalic margin slightly concave; median clypeus concave;
[MJ04] Mandibles six-toothed; basal three teeth more blunt than apical three teeth;
[MJ05] Eye length usually more than 0.07 mm, multi-faceted (some intermediates with smaller compound eyes);
[MJ06] Mesosoma massive (ML 0.68–0.96), with distinct promesonotal suture, developed scutellum, and band-shaped metanotum;
[MN01] Antennae with nine segments; when antennal scapes laid back, not surpassing posterior cephalic margin;
[MN02] Mandibles six-toothed; basal three teeth more blunt than apical three teeth;
[MN03] Anterior margin of median clypeus concave, with a pair of acutely protruded processes laterally;
[MN04] Promesonotum with four pairs of long erect hairs; three on pronotum, one on mesonotum; metanotal groove distinct;
[MN05] Propodeal spiracles posteriorly situated;
[MN06] Petiolar peduncle short, and petiolar node low in profile view (PI1 > 146).

The *C. oni* species group is distinguished from the *C. pygmaea* species group by the combination of following morphological characters (opposing character states in parentheses): antennae nine-segmented (eleven-segmented in the *C. pygmaea* species group); mandibles six-toothed (five-toothed); promesonotum of major workers roundly convex in profile view (distinctly convex to form a dome); propodeal spines present in minor workers (absent); petiolar node of minor workers low (higher). The *C. oni* species group can be easily distinguished from the *C. escherichi* species group by the presence of the major worker. Minor workers of the *C. oni* species group are distinguished from workers of the *C. escherichi* species group by the combination of following characters: distinct metanotal groove (indistinct in the *C. escherichi* group); low petiolar node (higher); presence of propodeal spines (absent).

Remarks. Liu et al. (2024) identified four morphological characters in the major worker subcastes of group members: a massive mesosoma; a short head (CI > 90); large size (TL > 3.4 mm); and the presence of ocelli. Our observations confirmed that massive mesosoma and short head are shared by the included species. However, "large size (TL > 3.4 mm)" should not be included, as TL is highly influenced by the measurement method and specimen condition. Alternatively, mesosomal length (ML) serves as a more stable indicator. Furthermore, caution is warranted regarding the presence of ocelli. Terayama (1996) noted intraspecific variation in the development of ocelli across the major workers of *C. oni*. Our samples confirmed that *C. eguchii* sp. nov. also includes individuals with and without ocelli, as does *C. oni*. Therefore, it is considered inappropriate to use such variable traits as diagnostic characters.

Liu et al. (2024) also provided a list of potential members of the species group: *C. altinoda*, *C. hunanensis*,

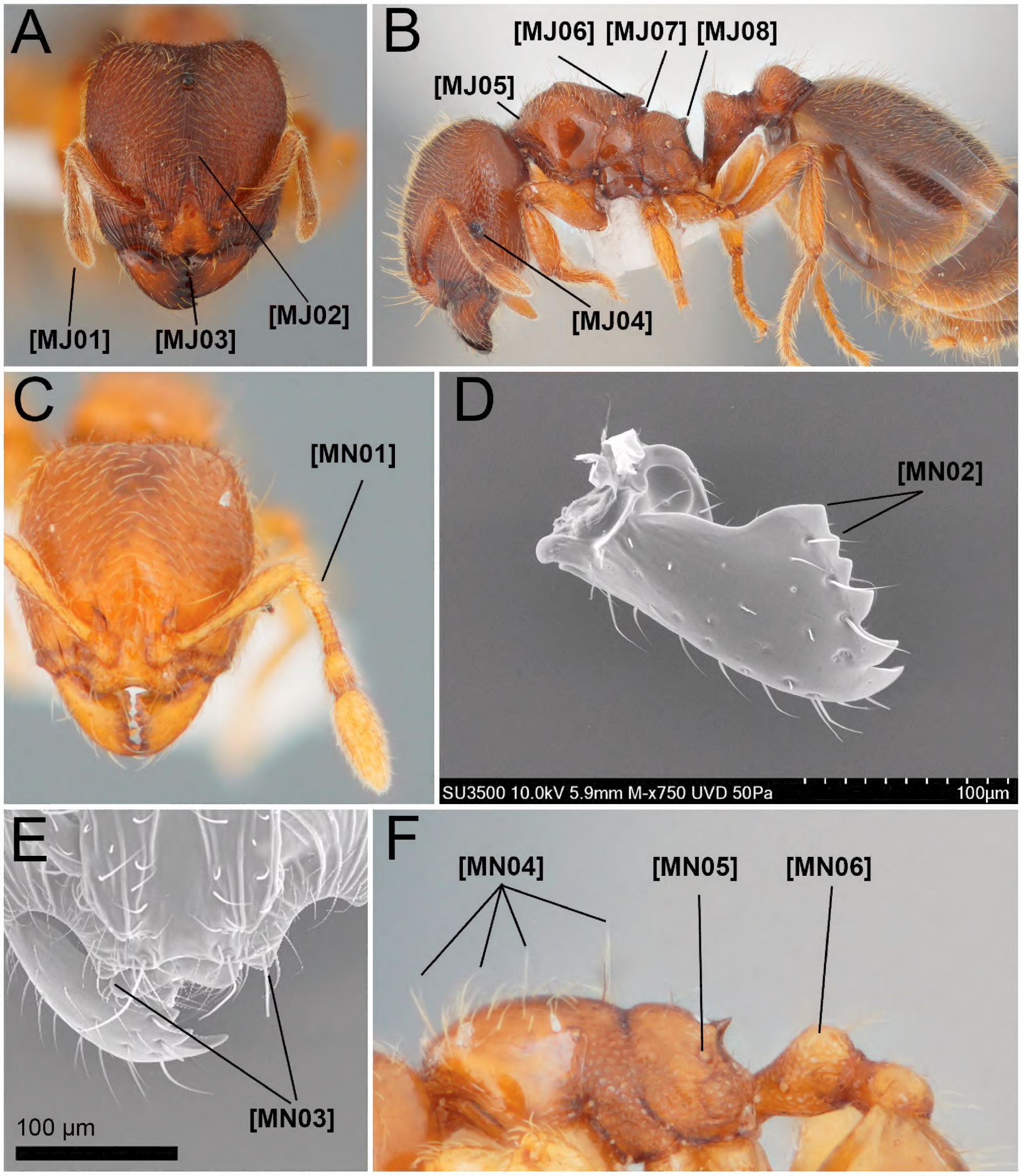

Figure 2. A–F. Diagnostic characters of the *Carebara oni* species group, *C. oni* (Terayama), worker. **A, B.** Major worker; **C–F.** Minor worker. **A.** Head in full-face view [MJ01–03]; **B.** Profile view of body [MJ04–08]; **C.** Head in full-face view [MN01]; **D.** Right mandible [MN02]; **E.** Clypeus [MN03]; **F.** Mesosoma and petiole in profile view [MN04–06].

C. oni, and *C. qianliyan*. Our examination of the original description and figures of *C. altinoda* (Xu 2003) confirm the following morphological characters: eleven-segmented antennae in majors and minors; and an unarmed propodeum as well as the absence of erect hairs on the promesonotum, petiole and postpetiole in minors. Furthermore, examination on the type-material of *C. qianliyan* revealed that, although it should exhibit eleven-segmented antennae, the original description mistakenly described it as nine-segmented antennae (Fig. 3). An unarmed propodeum and absence of erect hairs on the mesonotum, petiole, and postpetiole in minor workers were also confirmed in this species. These features are characteristic of the *C. pygmaea* species group. Therefore, it is reasonable to conclude that these two species are not members of the *C. oni* species group, and we consider that they might belong to the *C. pygmaea* species group. We have not been able to examine the type-material of *C. hunanensis*. We

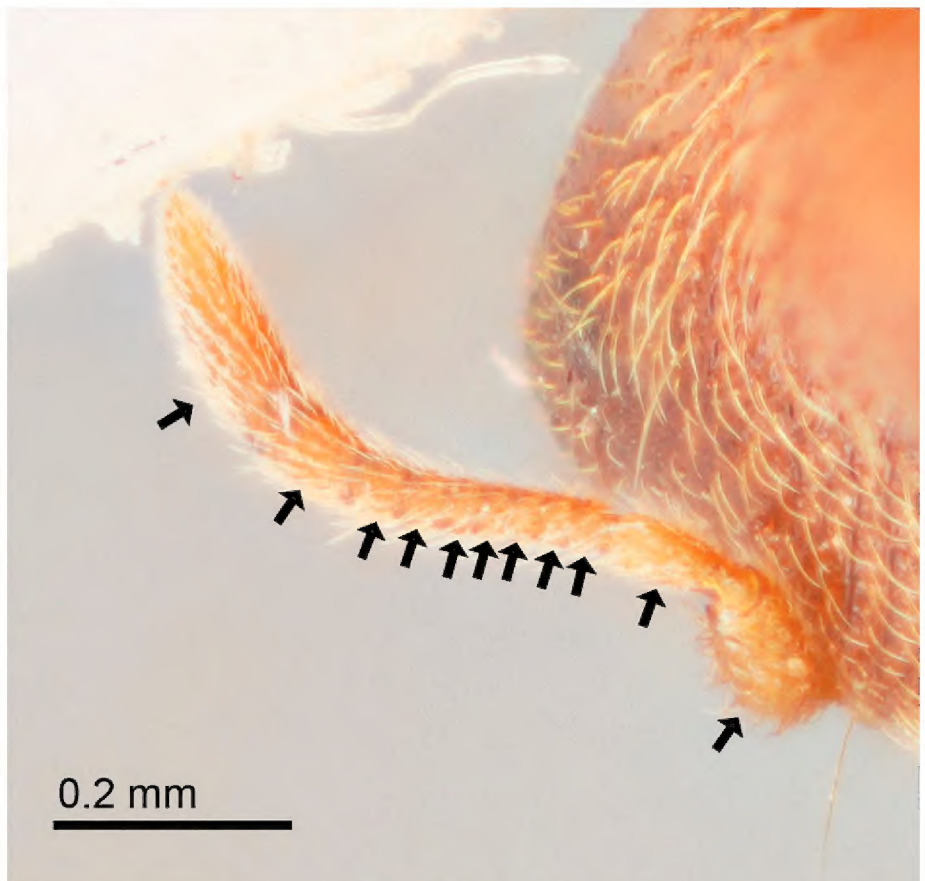

Figure 3. *Carebara qianliyan* Terayama, holotype major worker (NIAES) from Taiwan, right antenna. Each arrow indicates an antennal segment.

presume this species is a member of the *C. oni* species group, but its taxonomic status will remain uncertain until the type-material can be examined.

Our definition of the species group is based on morphological similarities among included taxa. Molecular phylogenetic analysis will be necessary to test the monophyly of the species group (Liu et al. 2024) and will serve as a useful aid to verify identification. It is important to develop a sound morphology-based taxonomy until fresh material for molecular work is available.

Distribution and biology. The members of the species group are distributed in northern Vietnam, Taiwan, and Japan (Okinawa Prefecture) (Fig. 4). Their nests are found in decayed wood.

List of species included in the *Carebara oni* species group

Carebara eguchii sp. nov.
Carebara bifida sp. nov.
Carebara oni (Terayama, 1996)

Figure 4. Geographical distribution of the *Carebara oni* species group.

Key to species in the *C. oni* species group based on the major worker caste

Keys are modified from Terayama (1996) and Liu et al. (2024).

1 Dorsal surface of promesonotum reticulate. Lateral surface of pronotum largely reticulate. Reticulation on dorsal surface of propodeum distinct. Subpetiolar process blunt (Fig. 5A) ..... *C. eguchii* sp. nov.
– Dorsal surface of promesonotum smooth and shiny. Lateral surface of pronotum entirely smooth and shiny. Reticulation on dorsal surface of propodeum indistinct. Subpetiolar process acute (Fig. 5B) 2
2 Lower portion of mesopleuron half anteriorly smooth and shiny, half posteriorly reticulate (Fig. 5C). Posterodorsal margin of petiolar node in profile view weakly curved (Fig. 5E) ..... *C. bifida* sp. nov.
– Lower portion of mesopleuron largely smooth and shiny (Fig. 5D). Posterodorsal margin of petiolar node in profile view strongly curved (Fig. 5F) ..... *C. oni*

Key to species in the *C. oni* species group based on the minor worker caste

1 Vertex, lateral propodeum, and dorsal surface of petiolar node smooth and shiny ..... *C. oni*
– Vertex, lateral propodeum, and dorsal surface of petiolar node reticulate 2
2 Dorsal surface of pronotum reticulate. Subpetiolar process absent. Posterior margin of propodeal spiracle not tangent to propodeal declivity (Fig. 5G) ..... *C. eguchii* sp. nov.
– Dorsal surface of pronotum smooth and shiny. Subpetiolar process acute. Posterior margin of propodeal spiracle almost tangent to propodeal declivity (Fig. 5H) ..... *C. bifida* sp. nov.

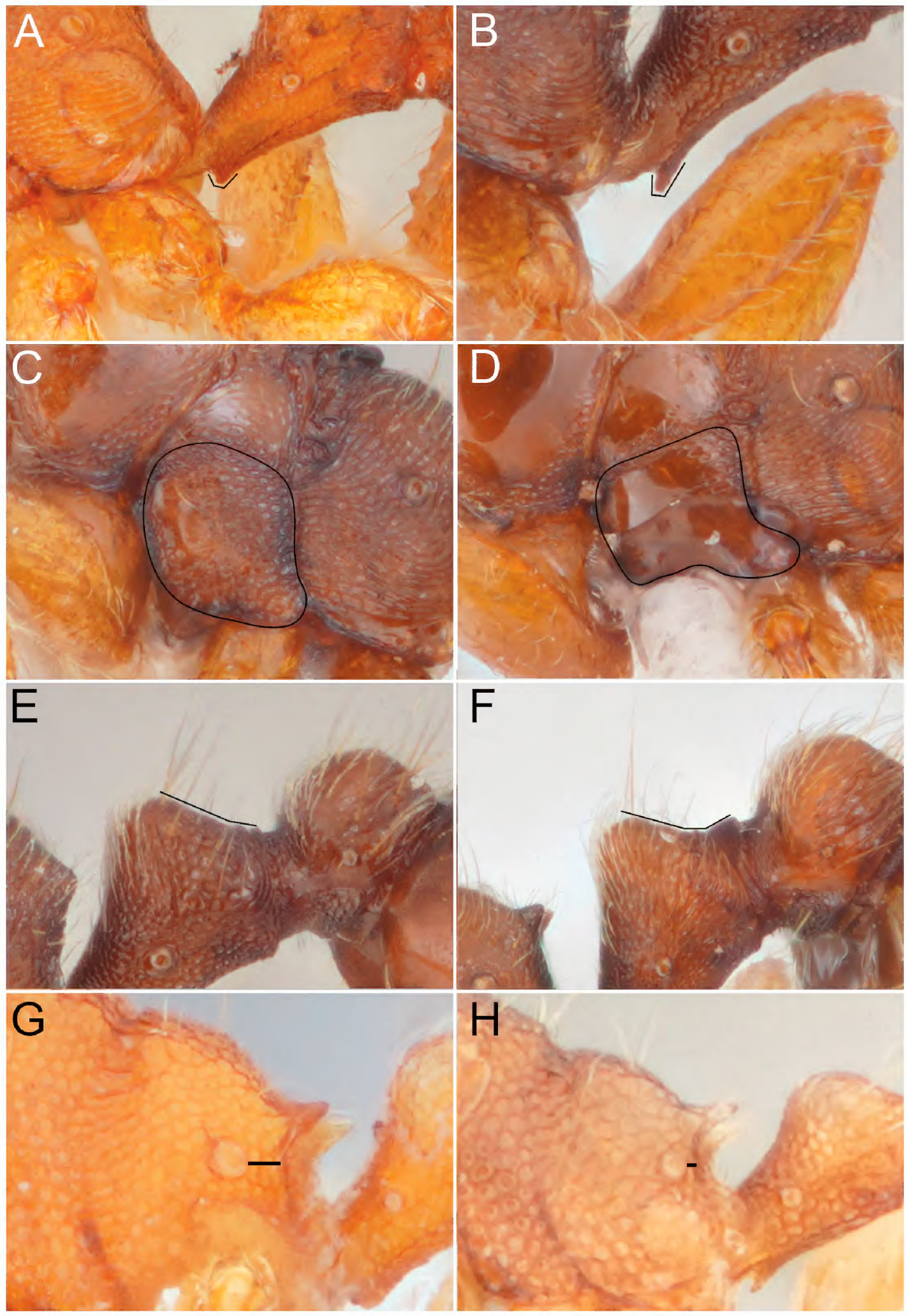

Figure 5. A–H. Morphological characters for the identification key based on workers of the *Carebara oni* species group. **A–F.** Major worker; **G, H.** Minor worker. **A.** *C. eguchii* sp. nov.; **B, C, E.** *C. bifida* sp. nov.; **D, F.** *C. oni* (Terayama). **A, B.** Subpetiolar process in profile view. Solid line indicates blunt/acute shape of subpetiolar process; **C, D.** Mesopleuron in profile view. Solid line indicates the lower portion of mesopleuron; **E, F.** Petiolar node in profile view. Solid line indicates the weakly/strongly curved posterodorsal margin of petiolar node; **G, H.** Propodeal spiracle. Solid line indicates the distance between propodeal spiracle and propodeal declivity.

Species accounts

Carebara eguchii Matsuura & Hosoishi, sp. nov.

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Fig. 6A–F

Type material examined. ***Holotype*: Vietnam** • major worker; Lai Chau, Western slope of Mt. Phansipan (W. Cong Troi); 2100–2200 m alt.; 6. May 2002; K. Eguchi leg.; colony Eg02-VN-316; VNMN, collection code KUECCRB011. ***Paratypes*: Vietnam** • 2 major workers and 2 minor workers; Lai Chau, Western slope of Mt. Phansipan (W. Cong Troi); 2100–2200 m alt.; 6. May 2002; K. Eguchi leg.; colony Eg02-VN-316; KUEC, collection codes KUECCRB012, 013; SKYC, collection codes KUECCRB014, 015.

Diagnosis of worker. Major worker: Dorsal surface of promesonotum reticulate. Lateral surface of pronotum largely reticulate. Reticulation on dorsal surface of propodeum distinct. Subpetiolar process blunt. **Minor worker:** Vertex reticulate. Dorsal surface of pronotum reticulate. Lateral propodeum reticulate. Propodeal spiracles not tangent to propodeal declivity. Dorsal surface of petiolar node reticulate. Subpetiolar process absent.

Measurements (in mm) and indices. Holotype (Major worker): TL 3.12, HL 0.87, HW 0.83, SL 0.41, EL 0.07, ML 0.96, MW 0.53, PSL 0.12, PSD 0.04, PL 0.39, PH 0.25, DPW 0.21, PPL 0.22, CI 95, SI 47, PI1 154, PI2 54. **Paratypes (Major worker, n=2):** TL 2.94–3.00, HL 0.81–0.86, HW 0.77–0.79, SL 0.39–0.41, EL 0.07–0.08, ML 0.88–0.90, MW 0.46–0.50, PSL 0.13–0.15, PSD 0.04, PL 0.35–0.37, PH 0.22–0.24, DPW 0.17–0.18, PPL 0.20–0.21, CI 92–94, SI 48, PI1 156–157, PI2 49–50. **Paratypes (Minor worker, n=2):** TL 1.86–1.91, HL 0.52, HW 0.51, SL 0.32, EL 0.03, ML 0.56, MW 0.30, PSL 0.07–0.08, PSD 0.03, PL 0.23, PH 0.14–0.15, DPW 0.11–0.12, PPL 0.12–0.13, CI 98, SI 60–61, PI1 157–161, PI2 50–51.

Description of worker. Worker caste dimorphic.

Major worker. (Fig. 6A–C).

Head in full-face view subsquare (CI 92–95); posterior cephalic border slightly concave in middle; posterolateral corners rounded; lateral margins slightly convex. Anterior clypeal margin concave in middle, with a pair of blunt protrusions. Frontal carinae present. Frontal triangle well-defined. Mandibles short, subtriangular, masticatory margins with six teeth that gradually decrease in size toward mandibular base. One median ocellus and two lateral ocelli present; in other specimen, ocelli absent or one median ocellus and one lateral ocellus present. Eyes with two or three ommatidia, situated at anterior one-third of head, laterally. Antennae with nine segments, with a two-segmented club; scapes narrower than eyes, clavate and slightly shorter than half of head length (SI 47–48); antennal segment II, VIII, and IX longer than wide, III–VII wider than long.

Mesosoma slightly longer than head (HL 0.81–0.87, ML 0.88–0.96). Promesonotum roundly convex and higher than propodeum in profile view; anterior and lateral margins of promesonotum convex in dorsal view; promesonotal suture distinct, distinctly or weakly convex forward in dorsal view. Dorsal outline of mesonotum concave in profile view; scutellum present. Mesopleuron separated by transverse striae. Metanotal groove present; metanotum present as elevated band. Dorsal outline of propodeum declining backwards; propodeal spiracle large (PSD 0.04) and rounded, situated above mid-height of propodeum and at mid-length of propodeum; propodeal spines blunt, short (PSL 0.12–0.15).

Petiole longer than high (PI1 154–157), with short peduncle and high node, broader posteriorly in dorsal view; ventral outline concave; subpetiolar process blunt. Postpetiole as long as high, shorter than petiole, lower than petiolar node in profile view; in dorsal view, postpetiole trapezoidal, wider than petiolar width. Gastral tergite I larger than remaining segments.

Frons with longitudinal irregular rugulae; vertex weakly areolate. Clypeus smooth and shiny medially, lateral sides longitudinally striated. Frontal triangle smooth and shiny. Frontal lobes longitudinally striated. Mandibles smooth and shiny. Cervical shield reticulate. Pronotum largely reticulate, partly smooth and shiny. Mesonotum reticulate anteriorly, remainder smooth and shiny. Scutellum smooth and shiny. Upper portion of mesopleuron partly smooth and shiny, remainder wrinkled and reticulate; lower portion of mesopleuron reticulate. Metapleuron reticulate and wrinkled. Propodeum reticulate. Legs smooth and shiny. Petiole reticulate. Disc of postpetiole smooth and shiny. Gastral tergite I smooth and shiny.

Head dorsally with abundant short decumbent and long erect hairs; vertex with short decumbent hairs. Anterior median clypeus with 2 pairs of long erect hairs. Mandibles, masticatory margins with long decumbent hairs; surface with short decumbent hairs. Antennal scapes with dense short decumbent hairs. Mesosoma with short decumbent and long erect hairs. Legs with short decumbent hairs. Petiolar node and postpetiole with long erect hairs. Gastral tergite I with short decumbent and sparsely long hairs.

Head, antennae, mesosoma, waist, gaster brown. Legs yellowish brown.

Minor worker. (Fig. 6D–F).

Head in full-face view almost as wide as long, subsquare (CI 98); posterior cephalic border almost straight; posterolateral corners rounded; lateral margins convex. Anterior clypeal margin concave in middle, with a pair of acute protrusions. Frontal carinae present. Frontal triangle well-defined. Mandibles short, subtriangular; masticatory margins with six teeth. Eyes with two ommatidia, situated at anterior one-third of lateral head. Antennae with nine segments, with a two-segmented club; scapes wider than eyes, clavate and longer than half of head length (SI 60–61); antennal segment II, VIII, and IX longer than wide, III–VII wider than long.

Mesosoma almost same size as head (HL 0.52, ML 0.56). Promesonotum roundly convex and higher than propodeum in profile view; in dorsal view, anterior mar-

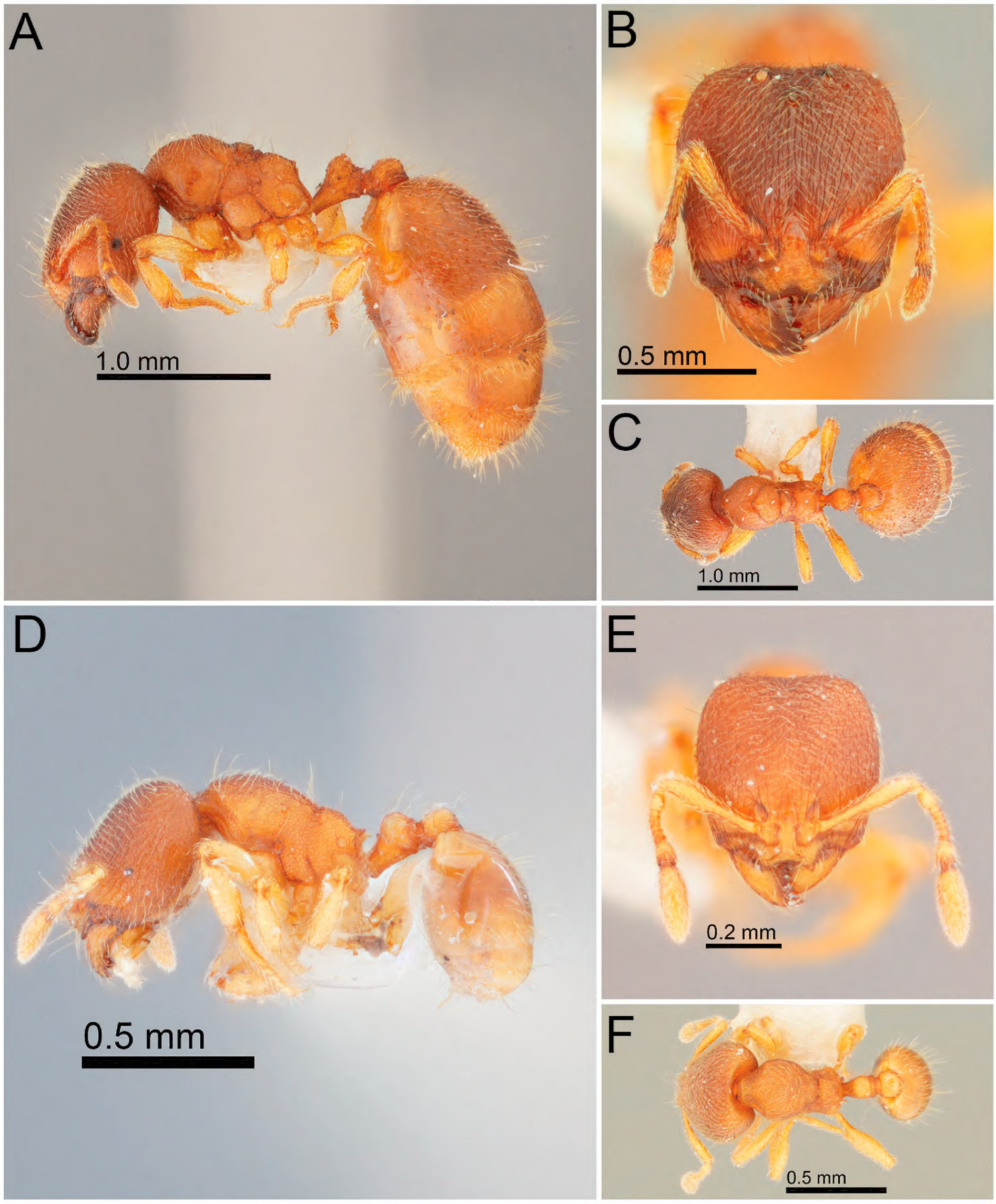

Figure 6. A–F. *Carebara eguchii* sp. nov. **A–C.** Holotype major worker (VNMN, collection code KUECCRB011) from Vietnam; **D–F.** Paratype minor worker (KUEC, collection code KUECCRB013) from Vietnam. **A, D.** Profile view of body; **B, E.** Head in full-face view; **C, F.** Dorsal view of body.

gin convex forward and lateral margins converging posteriorly; promesonotal suture indistinct. Mesopleuron not separated by transverse striae. Metanotal groove present. Dorsal outline of propodeum declining backwards; propodeal spiracle large (PSD 0.03), and rounded, situated above mid-height of propodeum and beyond mid-length of propodeum; propodeal spine acute, short (PSL 0.07–0.08); propodeal lamella thin in upper part, thick in lower part in profile view.

Petiole longer than high (PI1 157–161), with short peduncle and low node in profile view; dorsal outline between peduncle and node weakly curved in profile

view; in dorsal view, broader posteriorly; ventral outline slightly concave; subpetiolar process absent. In profile view, postpetiole shorter than petiole, lower than petiolar node; dorsal outline convex and ventral outline convex; in dorsal view, subrectangular, wider than petiolar width. Gastral tergite I larger than remaining segments.

Dorsal surface of head largely reticulate, only anterior part of frons longitudinally rugose. Clypeus smooth and shiny medially, lateral sides longitudinally striated. Frontal triangle smooth and shiny. Frontal lobes longitudinally striated. Mandibles smooth and shiny. Antennal scapes smooth and shiny. Cervical shield reticulate. Pronotum, mesonotum, mesopleuron and propodeum reticulate. Legs smooth and shiny. Petiole reticulate. Disc of postpetiole smooth and shiny. Gastral tergite I smooth and shiny.

Dorsal surface of head with short decumbent hairs and long erect hairs; vertex with short decumbent hairs. Anterior median clypeus with two pairs of long erect hairs. Mandibles, masticatory margins with long decumbent hairs; surface with short decumbent hairs. Antennal scapes with dense short decumbent hairs. Mesosoma with short decumbent hairs and long erect hairs; promesonotum with four pairs of long erect hairs, three of them situated at pronotum, one of them situated at mesonotum; propodeum with a pair of long erect hairs, situated at middle of dorsal outline of propodeum. Legs with short decumbent hairs. Petiolar node and postpetiole with long erect hairs. Gastral tergite I with long decumbent and sparsely erect hairs.

Head, mesosoma, waist, gaster brown. Antennae and legs yellowish brown.

Etymology. The species name *eguchii* is derived from the Japanese entomologist Dr. Katsuyuki Eguchi, who collected the type series.

Distribution. Vietnam (Mt. Phansipan)

Remarks. Three intermediates are recognized within the major worker subcaste of this species (Fig. 7). Ocelli are absent in intermediate 1; one median and one lateral ocellus are present in intermediate 2; and one median and two lateral ocelli are present in intermediate 3. Forward convexity of promesonotal suture in dorsal view becomes more pronounced from intermediate 1 to 3.

This species corresponds to *Oligomyrmex* sp. eg-2 shown in Eguchi et al. (2011).

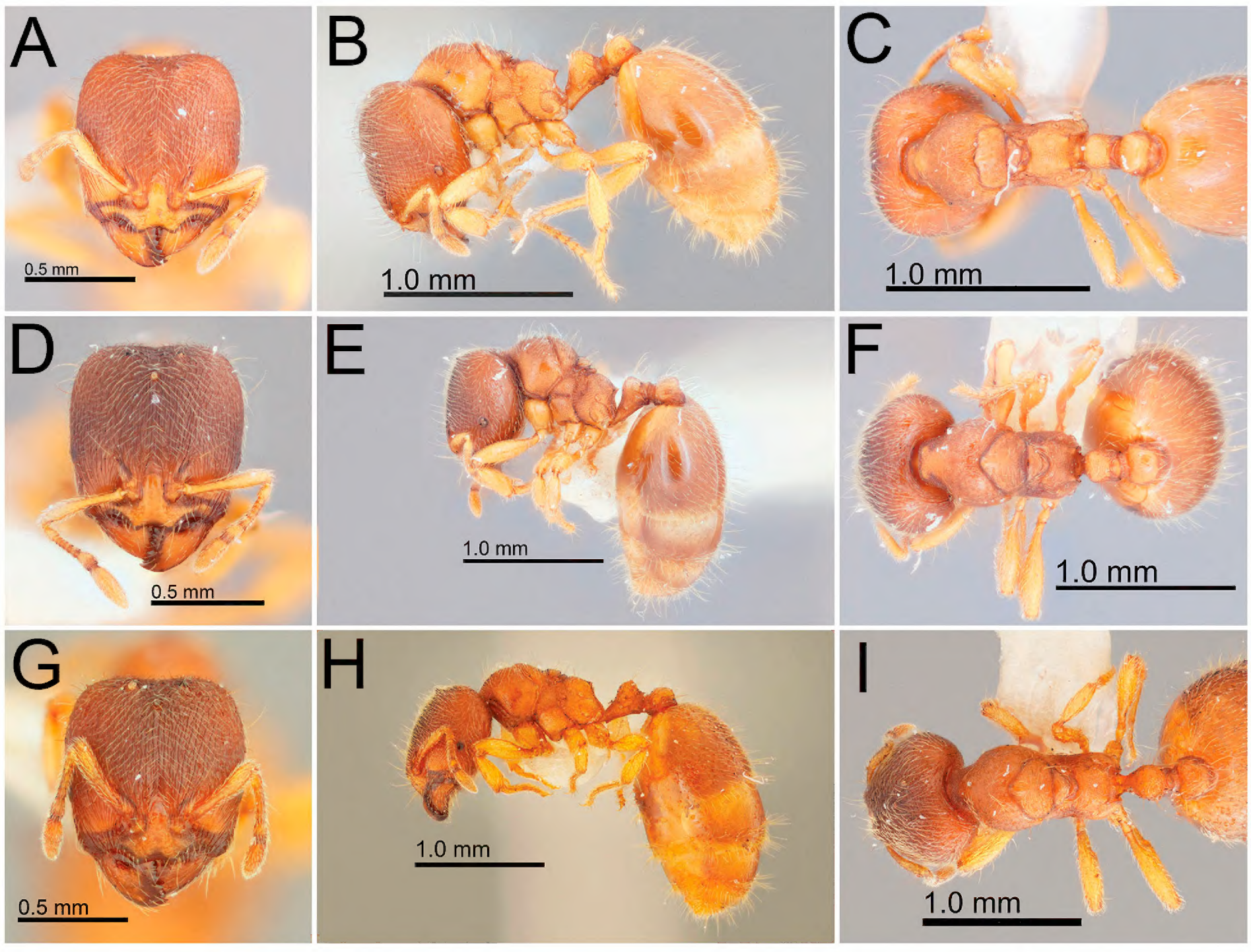

Figure 7. A–I. Intermediates of *Carebara eguchii* sp. nov. **A–C.** Intermediate 1 (Paratype, collection code KUECCRB012); **D–F.** Intermediate 2 (Paratype, collection code KUEC014); **G–I.** Intermediate 3 (Holotype, collection code KUECCRB011). **A, D, G.** Head in full-face view; **B, E, H.** Profile view of body; **C, F, I.** Dorsal view of body.

Carebara bifida Matsuura & Hosoishi, sp. nov.

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Fig. 8A–F

Type material examined. ***Holotype*: Vietnam** • major worker; Cuc Phuong National Park, Ninh Binh Province; 20°14'N, 105°36'E; 25. Aug. 2019; S. Hosoishi leg.; dead wood; colony SH19-Vie-73; VNMN, collection code KUECCRB016. ***Paratypes*: Vietnam** • 2 major workers and 10 minor workers; Cuc Phuong National Park, Ninh Binh Province; 20°14'N, 105°36'E; 25. Aug. 2019; S. Hosoishi leg.; dead wood; colony SH19-Vie-73; KUEC, collection code KUECCRB017, 018, 019, 020, 021, 022, SKYC, collection code KUECCRB023, 024, 025, 026, 027, 028.

Non-type material examined. Vietnam • 1 major worker and 1 minor worker; Chua Yen Tu, Quang Ninh Province; 21°09'N, 106°43'E; 720–845 m alt.; 20. May 2019; K. Eguchi leg.; rotting part of living tree bamboo forest; colony Eg04-VN-065; ACEG. 1 major worker and 1 minor worker; W. Yen Tu, Bac Giang Province; 21°10'18.1"N, 106°43'16.0"E; ca. 370 m alt.; 2. Apr. 2003; K. Eguchi leg.; colony Eg03-VN-163; ACEG. 1 minor worker; Nam Xe, Van Ban District, Lao Cai Province; 620–700 m alt.; 2. Oct. 2006; K. Eguchi leg.; colony Eg02x06-03; ACEG.

Diagnosis of worker. Major worker: Dorsal surface of promesonotum smooth and shiny. Lateral surface of pronotum entirely smooth and shiny. Lower portion of mesopleuron punctate posteriorly, smooth and shiny anteriorly. Reticulation on dorsal surface of propodeum indistinct. Posterodorsal margin of petiolar node in profile view weakly curved. Subpetiolar process acute. **Minor worker:** Vertex reticulate. Lateral margin of head converging, not parallel in full-face view. Dorsal surface of pronotum smooth and shiny. Propodeal spiracles almost tangent to propodeal declivity. Lateral propodeum reticulate. Dorsal surface of petiolar node reticulate. Subpetiolar process acute.

Measurements (in mm) and indices. Holotype (Major worker): TL 2.97, HL 0.76, HW 0.68, SL 0.40, EL 0.10, ML 0.68, MW 0.38, PSL 0.12, PSD 0.03, PL 0.35, PH 0.22, DPW 0.17, PPL 0.18, CI 90, SI 52, PI1 159, PI2 50. **Paratype (Major worker, n=2):** TL 2.82–3.03, HL 0.74–0.75, HW 0.70–0.71, SL 0.35–0.36, EL 0.10–0.12, ML 0.73–0.77, MW 0.36–0.40, PSL 0.11–0.17, PSD 0.03–0.04, PL 0.35–0.37, PH 0.21–0.23, DPW 0.17–0.18, PPL 0.16–0.19, CI 94, SI 46–49, PI1 162–164, PI2 44–47. **Paratype (Minor worker, n=10):** TL 1.05–1.41, HL 0.36–0.41, HW 0.34–0.38, SL 0.20–0.26, EL 0.01, ML 0.37–0.42, MW 0.21–0.23, PSL 0.06–0.08, PSD 0.02–0.03, PL 0.16–0.17, PH 0.10–0.11, DPW 0.07–0.08, PPL 0.08–0.09, CI 89–100, SI 55–63, PI1 152–172, PI2 44–58.

Description of worker. Worker caste dimorphic.

Major worker. (Fig. 8A–C).

Head in full-face view subsquare (CI 90–94); posterior cephalic border concave in middle; posterolateral corners rounded; lateral margins slightly convex. Anterior clypeal margin concave in middle, with a pair of blunt protrusions. Frontal carinae inconspicuous. Frontal triangle well-defined. Mandibles short, subtriangular, masticatory margins with six teeth; apical three teeth large, basal three teeth smaller. One median ocellus and two tubercles present; in other specimens, one median ocellus and two lateral ocelli present, tubercles absent. Eyes large, ten ommatidia visible, situated at anterior one-third of lateral head. Antennae with nine segments, with a two-segmented club; scapes narrower than eye, clavate, almost half of the head length (SI 46–52); antennal segment II, VIII, and IX longer than wide, III–VII wider than long.

Mesosoma almost same size as head (HL 0.74–0.76, ML 0.68–0.77). Promesonotum roundly convex and higher than propodeum in profile view; anterior and lateral margins of promesonotum convex in dorsal view; promesonotal suture distinct, convex forward in dorsal view. Dorsal outline of mesonotum concave in profile view; scutellum present. Metanotal groove present; metanotum present as elevated band. Dorsal outline of propodeum declining backwards; propodeal spiracle large (PSD 0.03–0.04) and rounded, situated above mid-height of propodeum and beyond mid-length of propodeum; propodeal spine blunt, short (PSL 0.11–0.17).

Petiole longer than high (PI1 159–164), with short peduncle and high node, broader posteriorly in dorsal view; ventral outline concave; subpetiolar process acute. Postpetiole higher than long, shorter than petiole, lower than petiolar node in profile view; in dorsal view, postpetiole elliptical, wider than petiolar width. Gastral tergite I larger than remaining segments.

Frons and anterior part of vertex with longitudinal irregular rugulae. Clypeus smooth and shiny medially, lateral sides longitudinally striated. Frontal triangle smooth and shiny. Frontal lobes longitudinally striated. Mandibles smooth and shiny. Pronotum, mesonotum, and scutellum smooth and shiny. Upper portion of mesopleuron smooth and shiny (in other specimens, mesopleuron reticulate); lower portion of mesopleuron reticulate posteriorly, smooth and shiny anteriorly. Metapleuron reticulate. Dorsum of propodeum weakly reticulate; lateral surface reticulate. Legs smooth and shiny. Petiole reticulate. Disc of postpetiole smooth and shiny. Gastral tergite I smooth and shiny.

Dorsum of head with abundant short decumbent and sparsely long erect hairs; vertex with short decumbent hairs. Anterior median clypeus with two pairs of long erect hairs. Mandibles, masticatory margins with long decumbent hairs; surface with short decumbent hairs. Antennal scapes with dense decumbent hairs. Mesosoma with short decumbent and long erect hairs. Legs with short decumbent hairs. Petiolar node and postpetiole with long erect hairs. Gastral tergite I with short decumbent and sparsely long erect hairs.

Head, mesosoma, waist and gaster dark brown. Antennae and legs yellowish brown.

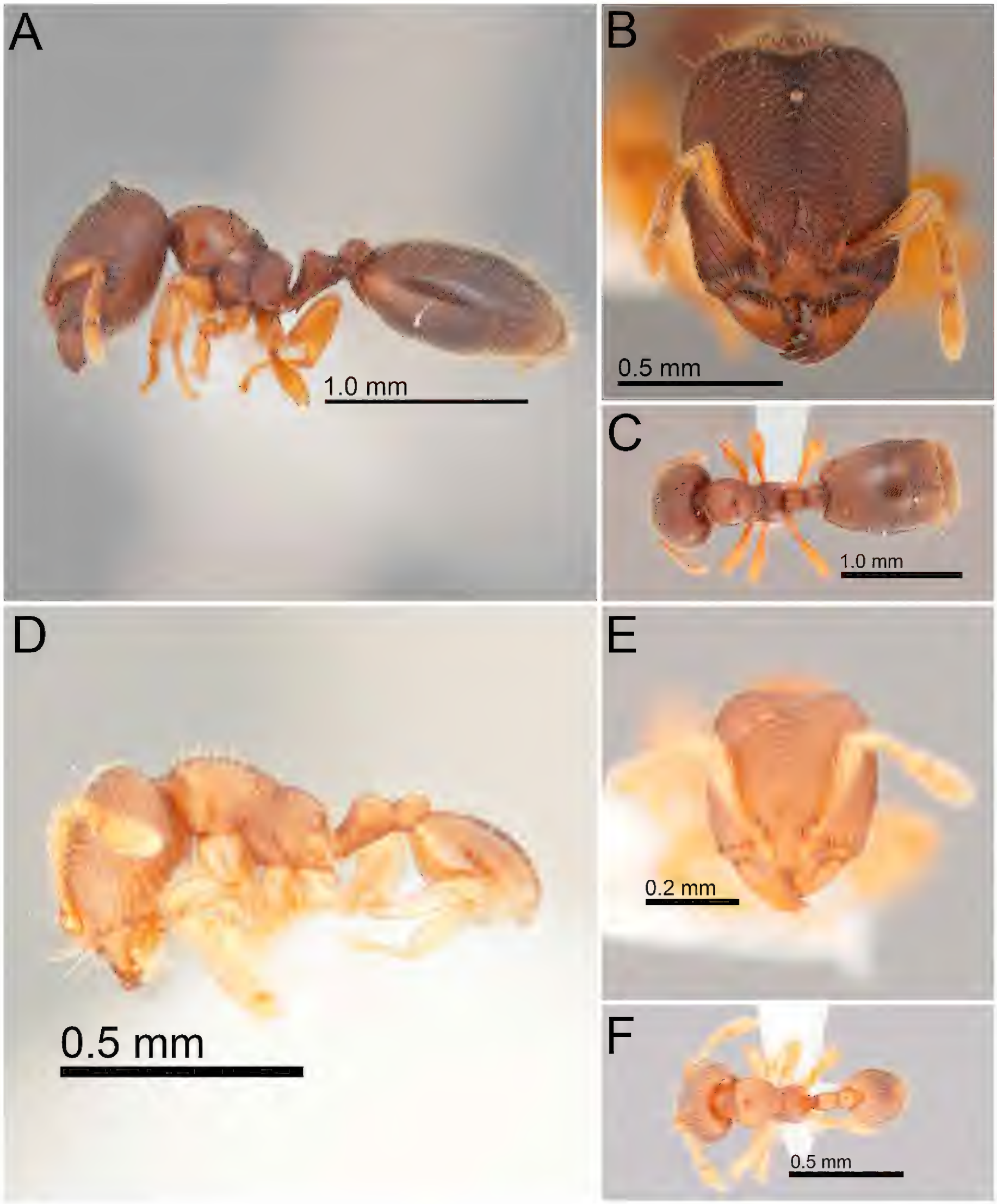

Figure 8. A–F. *Carebara bifida* sp. nov. **A–C.** Holotype major worker (VNMN, collection code KUECCRB016) from Vietnam; **D–F.** Paratype minor worker (KUEC, collection code KUECCRB019) from Vietnam. **A, D.** Profile view of body; **B, E.** Head in full-face view; **C, F.** Dorsal view of body.

Minor worker. (Fig. 8D–F).

Head in full-face view almost as wide as long, subsquare (CI 89–100); posterior cephalic border almost straight; posterolateral corners rounded; lateral margins convex. Anterior clypeal margin concave in middle, with a pair of acute protrusions. Frontal carinae present. Frontal triangle well-defined. Mandibles short, subtriangular; masticatory margins with six teeth. Eyes with one ommatidium, situated laterally at anterior one-third of head. Antennae with nine segments, with a two-segmented club; scapes wider than eyes, clavate and longer than half of head length (SI 55–63); antennal segment II, VIII, and IX longer than wide, III–VII wider than long.

Mesosoma almost same size as head (HL 0.36–0.41, ML 0.37–0.42). Promesonotum roundly convex and higher than propodeum in profile view; in dorsal view, anterior margin convex forward and lateral margins converging posteriorly; promesonotal suture indistinct. Me-

sopleuron not separated by transverse striae. Metanotal groove present. Dorsal outline of propodeum declining backwards; propodeal spiracle large (PSD 0.02–0.03) and rounded, situated above mid-height of propodeum, touching propodeal declivity; propodeal spines acute, short (PSL 0.06–0.08); propodeal lamella thin in upper part, thick in lower part in profile view.

Petiole longer than high (PI1 152–172), with short peduncle and low node in profile view; dorsal outline between peduncle and node weakly curved in profile view; in dorsal view, broader posteriorly; ventral outline straight; subpetiolar process acute, towards forward. In profile view, postpetiole shorter than petiole, lower than petiolar node; dorsal outline convex and ventral outline slightly concave; in dorsal view, wider than petiolar width, rounded. Gastral tergite I larger than remaining segments.

In full-face view, frons longitudinally striated, rest of dorsal surface of head reticulate. Clypeus smooth and shiny medially, lateral sides longitudinally striated. Frontal triangle smooth and shiny. Frontal lobes longitudinally striated. Mandibles smooth and shiny. Antennal scape smooth and shiny. Cervical shield punctate. Pronotum shiny and slightly wrinkled. Mesonotum, mesopleuron and propodeum reticulate. Legs smooth and shiny. Petiole reticulate. Disc of postpetiole smooth and shiny. Gastral tergite I smooth and shiny.

Dorsal surface of head with short decumbent hairs and long erect hairs; vertex with short decumbent hairs. Anterior median clypeus with two pairs of long erect hairs. Mandibles, masticatory margins with long decumbent hairs; surface with short decumbent hairs. Antennal scape with dense short decumbent hairs. Mesosoma with short decumbent hairs and long erect hairs; promesonotum with four pairs of long erect hairs, three of them situated at pronotum, one situated at mesonotum; propodeum with a pair of long erect hairs, situated at middle of dorsal outline of propodeum. Legs with short dense decumbent hairs. Petiolar node and postpetiole with long erect hairs. Gastral tergite I with long decumbent and sparsely erect hairs.

Head, mesosoma, waist, gaster brown. Antennae and legs yellowish brown.

Etymology. The species is named after the strongly forked median clypeus of the minor worker.

Habitat. The type specimens were collected from dead wood.

Distribution. Vietnam (Lao Cai, Ninh Binh, Quang Ninh and Bac Giang Province)

Remarks. Three intermediates are recognized within the major worker subcaste of this species (Fig. 9). Num-

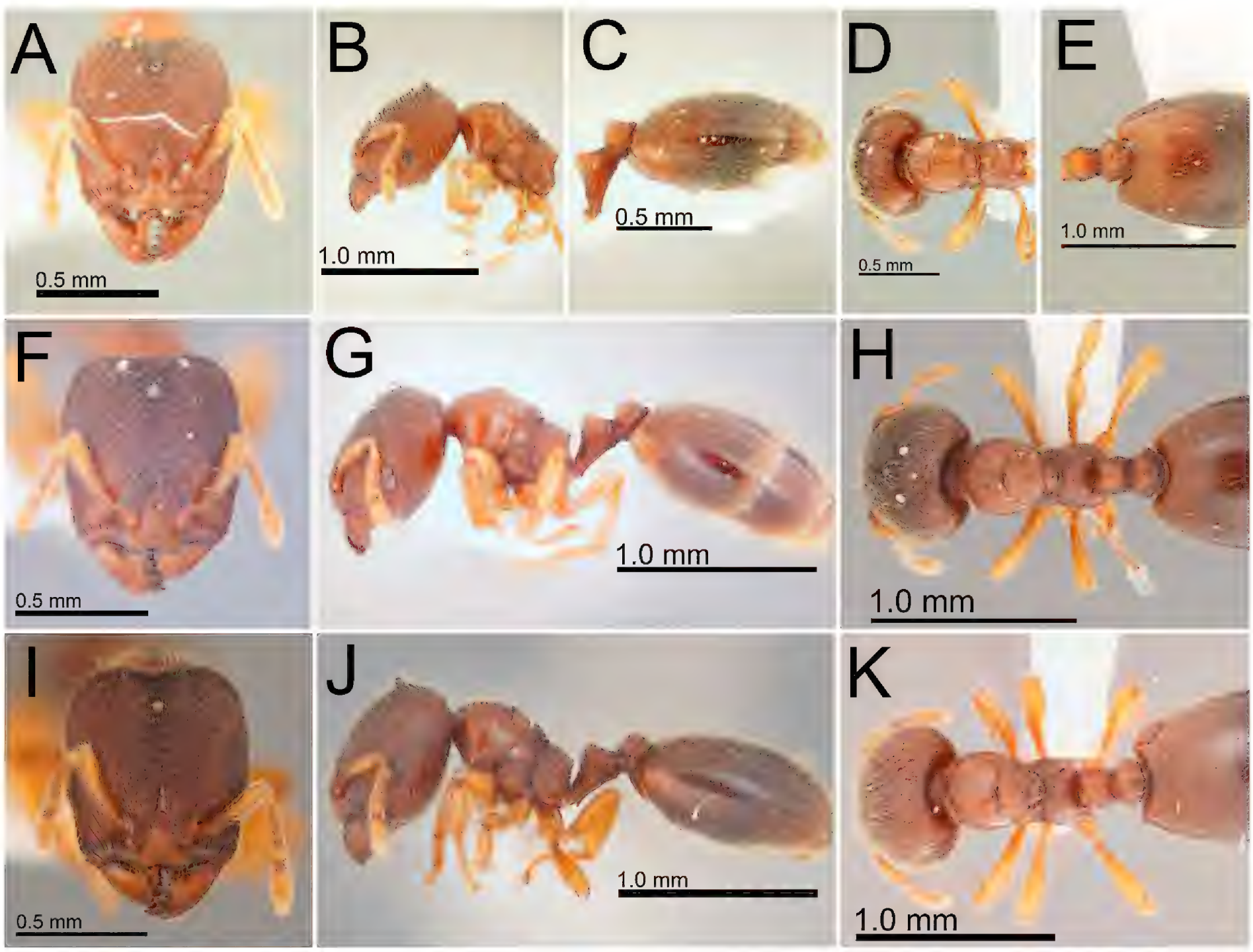

Figure 9. A–K. Intermediates of *Carebara bifida* sp. nov. **A–E.** Intermediate 1 (Paratype, SKYC, collection code KUECCRB017); **F–H.** Intermediate 2 (Paratype, KUEC, collection code KUECCRB023); **I–K.** Intermediate 3 (Holotype, VNMN, collection code KUECCRB016). **A, F, I.** Head in full-face view; **B, C, G, J.** Profile view of body; **D, E, H, K.** Dorsal view of body.

ber of ocelli is variable (one to three). Forward convexity of promesonotal suture in dorsal view is variable. Sculpture in upper part of mesopleuron is variable (smooth and shiny to reticulate).

This species corresponds to *Oligomyrmex* sp. eg-1 shown in Eguchi et al. (2011).

Carebara oni (Terayama, 1996)

Fig. 10A–F

Oligomyrmex oni Terayama, 1996: 20, major worker, minor worker.

Combination in *Carebara*. Terayama, 2009: 151.

Non-type material examined. Japan • 7 major workers and 4 minor workers; Okinawa pref., Nago-shi, Katsuu-dake, 370 m alt.; 28. Sep. 2023; Kh. Matsuura and S. Hosoishi leg.; decayed wood; colony KM23-OKN-1; KUEC. 1 major worker; Okinawa pref., Kunigami-son, iji, Ohkuni forestry road; 29. Sep. 2023; Kh. Matsuura and S. Hosoishi leg.; decayed wood; colony KM23-OKN-2; KUEC. 4 major workers; Okinawa pref., Kunigami-son, iji, Ohkuni forestry road; 19. Sep. 2024; T. Nakazono leg.; under a stone; KUEC.

Diagnosis of worker. Major worker: Dorsal surface of promesonotum smooth and shiny. Lateral surface of pronotum entirely smooth and shiny. Lower portion of mesopleuron largely smooth and shiny. Reticulation on dorsal surface of propodeum indistinct. Posterodorsal margin of petiolar node in profile view strongly curved. **Minor worker:** Vertex, lateral propodeum, and dorsal surface of petiolar node smooth and shiny.

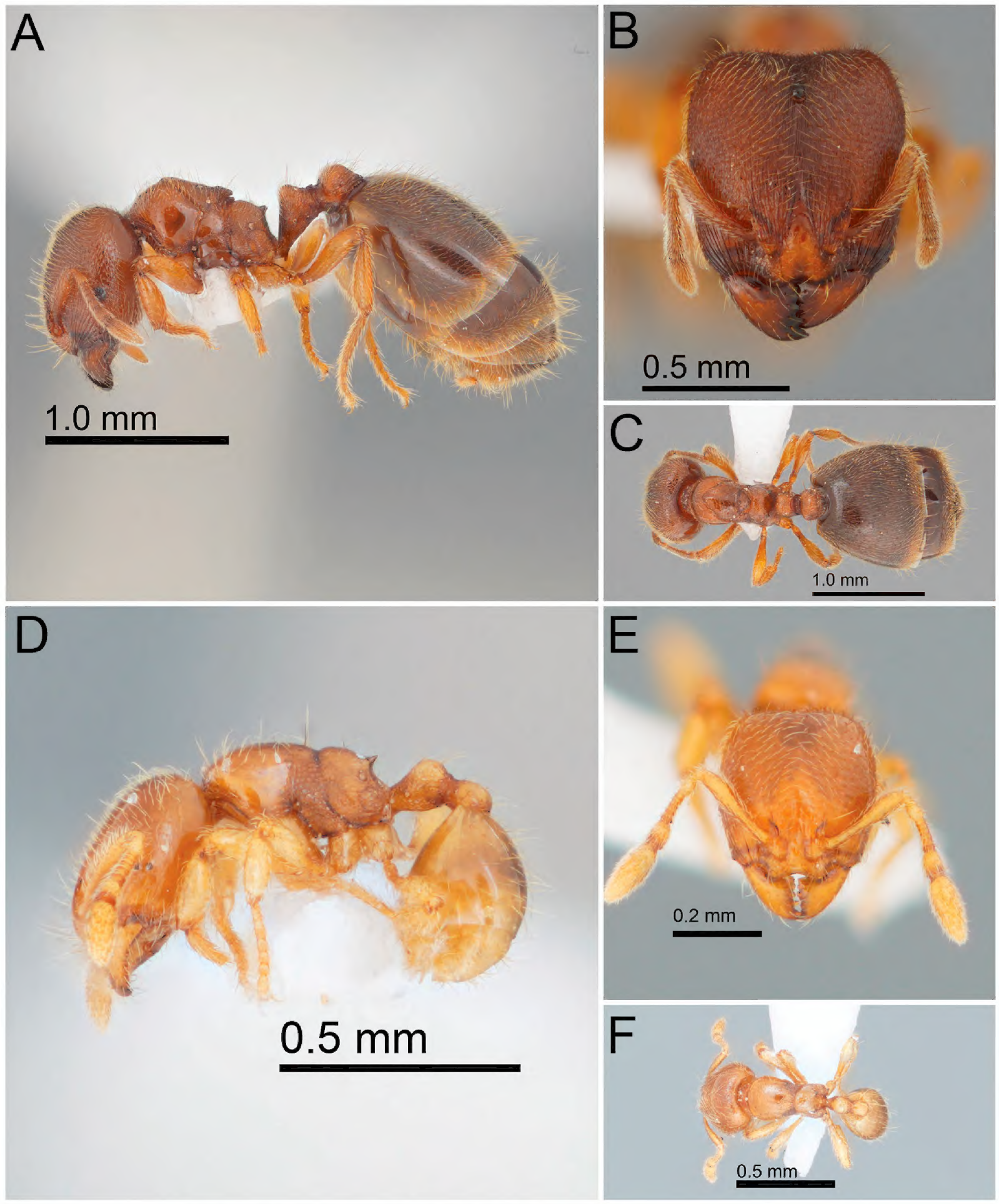

Figure 10. A–F. *Carebara oni* (Terayama). **A–C.** Major worker (KUEC) from Japan; **D–F.** Minor worker (KUEC) from Japan. **A, D.** Profile view of body; **B, E.** Head in full-face view; **C, F.** Dorsal view of body.

Measurements (in mm) and indices. Major worker (n=12): TL 2.76–3.44, HL 0.65–0.89, HW 0.63–0.82, SL 0.35–0.41, EL 0.03–0.09, ML 0.73–0.92, MW 0.35–0.46, PSL 0.11–0.17, PSD 0.03–0.05, PL 0.34–0.44, PH 0.22–0.27, DPW 0.17–0.25, PPL 0.22–0.28, CI 90–98, SI 42–54, PI1 147–171, PI2 51–62. **Minor worker (n=4):** TL 1.24–1.31, HL 0.38–0.39, HW 0.34–0.36, SL 0.22–0.23, EL 0.01–0.02, ML 0.37–0.39, MW 0.20–0.23, PSL 0.05–0.06, PSD 0.02, PL 0.15–0.17, PH 0.10–0.11, DPW 0.07–0.08, PPL 0.08–0.09, CI 88–94, SI 57–61, PI1 146–151, PI2 47–49.

Remarks. The original description and figure (Terayama 1996) closely match the specimens examined. Based on worker morphology, the specimens from Okinawa are herein determined as *C. oni*.

Five intermediates are recognized for the major worker of this species (Fig. 11). Eyes are smaller and reduced in intermediate 1, while intermediates 2 to 5 have larger

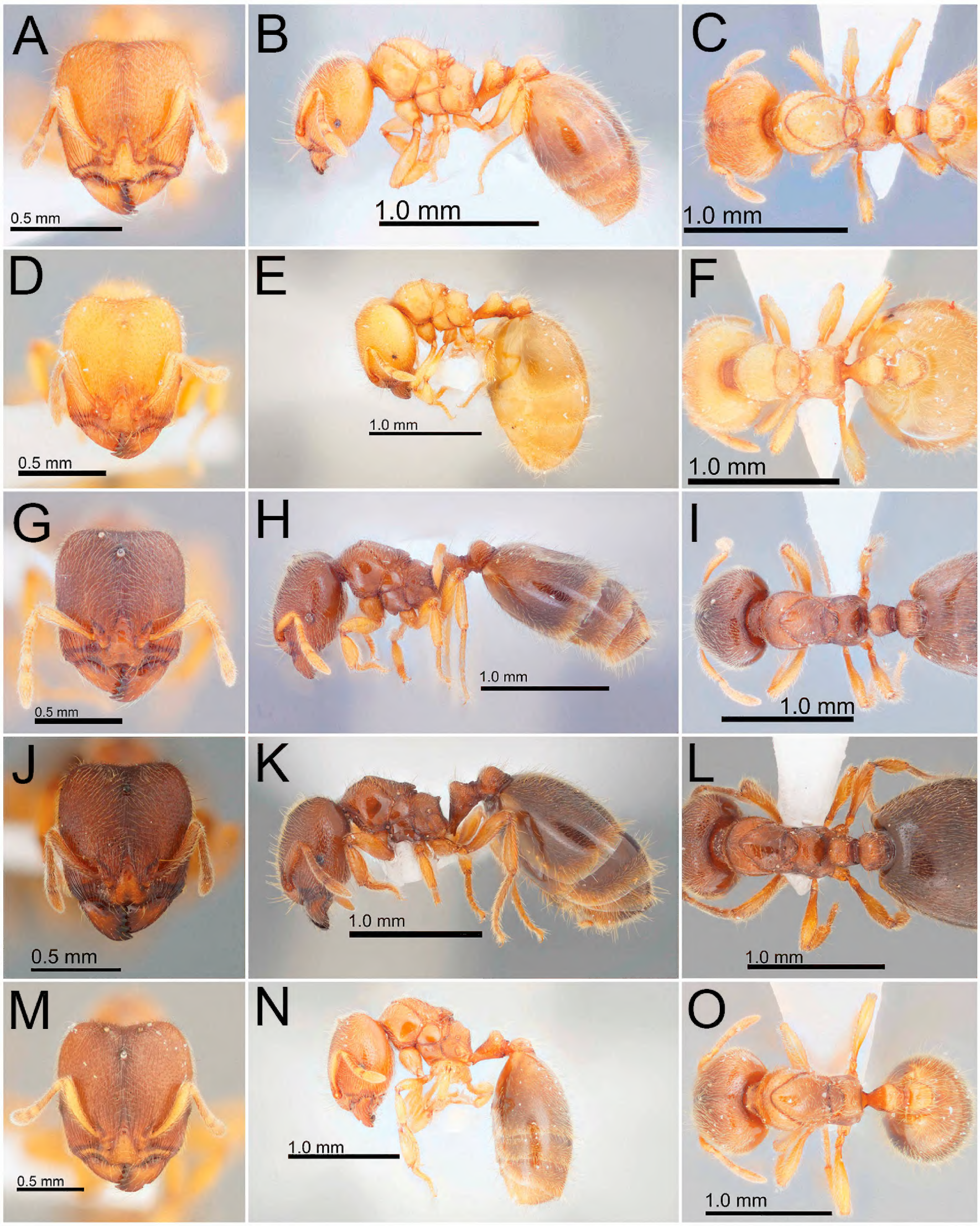

Figure 11. A–O. Intermediates of *Carebara oni* (Terayama). **A–C.** Intermediate 1; **D–F.** Intermediate 2; **G–I.** Intermediate 3; **J–L.** Intermediate 4; **M–O.** Intermediate 5. **A, D, G, J, M.** Head in full-face view; **B, E, H, K, N.** Profile view of body; **C, F, I, L, O.** Dorsal view of body.

and multi-faceted eyes. States of ocelli are diverse in each intermediate: one indistinct ocellus in intermediate 1; one median ocellus and one lateral ocellus in intermediate 2; one ocellus in intermediate 3; one ocellus and two horns in intermediate 4; one ocellus and two lateral ocelli in intermediate 5. Promesonotal suture in dorsal view is gradually getting convex forward from intermediates 1 to 5. Propodeum unarmed in intermediates 5, while others have short spines. Body color of intermediate 1 is in yellow.

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